Macdonald Royal Commission's technology and industrial policy

BP-150E

THE MACDONALD ROYAL COMMISSION'S TECHNOLOGY AND INDUSTRIAL POLICY

Scott Tiffin

Science and Technology Division
Research Branch
Ottawa

16 May 1986

LIBRARY OF PARLIAMENT

BP-150E

THE MACDONALD ROYAL COMMISSION'S TECHNOLOGY AND INDUSTRIAL POLICY

Scott Tiffin

Science and Technology Division
Research Branch
Ottawa

16 May 1986

Cat. No. YM32-2/150E

ISBN 0-660-12441-6

TABLE OF CONTENTS

THE MACDONALD ROYAL COMMISSION'S TECHNOLOGY AND INDUSTRIAL POLICY

INTRODUCTION

The Macdonald Royal Commission (MRC) tells us that it has carried out "the most extensive research program in Canadian history".(1) The Commission's final Report, whose massive size indicates great breadth of investigation, and in many areas substantial depth, repeatedly makes general statements on the importance of technology. This paper will discuss how the Commission would have done well to analyze the specific ways in which technology will affect Canada's future economic development. In particular it will argue that the field of research and public policy dealing specifically with technology must be taken into account in such discussion and that the Commission's main recommendations on free trade and the primacy of market forces are not consistent with the general importance it has accorded to technology.

This paper undertakes to:

- show that the MRC accords great importance to technology in a general sense, but ought to have elaborated on the specific ways in which technology interacts with industry and trade;
- explain that the MRC Report presents a very selective industrial policy analysis and would have benefited from more adequate reference to another intellectual viewpoint called technology policy;
- discuss the analysis dealing with industry and trade that affects Canada's current position on these issues; and
- outline general recommendations arising from the technology policy viewpoint.

---

(1) Canada, Royal Commission on the Economic Union and Development Prospects for Canada, Donald S. Macdonald, Chairman, Report, Part I, Supply and Services, Ottawa, 1985, p. xx.

THE COMMISSION'S VIEW OF TECHNOLOGY

The Commission Report stresses the fundamental importance of technology.

> We can be sure...that the rapid advance of science and technology is bringing about far-reaching changes which will require adjustments...in virtually all aspects of society.(1)

> The challenge posed by technology also has a global aspect - both economic and political - which will, of itself, force the rethinking of traditional solutions.(2)

> Advances in science and technology will clearly continue to shape our natural, human, economic and international environments.(3)

Such assertions have met with wide agreement. Technology has had, and will continue to have, enormous repercussions on our way of life.

The Commission realizes that technology is an important factor in direct economic competition among nations.

> Attention has turned more and more to technology's contribution to economic growth.(4)

> Many observers claim that Western societies are in the midst of a major and fundamental transition based on an increase in the pace of technological progress.(5)

> To an important extent, Canada's future trade performance will depend on our country's manufacturing performance... All this puts a premium on innovation, on the capacity to increase output rapidly, and on the ability to capture market share.(6)

---

(1) Ibid., p. 125.

(2) Ibid., p. 126.

(3) Ibid., p. 117.

(4) Ibid., p. 157.

(5) Ibid., p. 162.

(6) Ibid., p. 267.

The Commission goes on to castigate the Soviet Union for a

> ...failure to become a technological society, despite its considerable progress towards becoming an industrial society. Continuing imports of required technology tend to perpetuate and exacerbate existing weaknesses in the domestic development of innovative technologies.(1)

After such forceful statements, one would expect that technology would be important throughout the whole Report, and a central factor in the sections dealing with economic growth, productivity and industrial development. The space devoted to an explicit examination of technology, however, comprises only some three dozen pages out of a total of almost two thousand in the whole Report.

Furthermore, the two main sections on technology (Knowledge Environment and Technological Progress) are isolated from the rest of the text instead of being tightly linked to the subsequent discussions of economic, political, social and environmental factors in Canada's future. In fact, the Commission seems to see technology as a rather disembodied, external factor, one which is largely unrelated in its development to daily political, social and economic events, something that is available off-the-shelf, when needed. The Commission emphasizes the impacts of technology on society in the broadest sense. It would have been useful, however, to see general pronouncements like "Technological progress is not a panacea for the world's problems"(2) placed within a context of detailed analysis and to have references made to the abundant literature dealing with these important questions.(3)

---

(1) Ibid., p. 183.

(2) Ibid., p. 197.

(3) See for example: Jacques Ellul, The Technological Society, Alfred Knopf, New York, 1964; Lewis Mumford, The Myth of the Machine, Harcourt, Brace, Jovanovich, New York, 1970; Herbert Marcuse, One-Dimensional Man, Beacon Press, Boston, 1964; Langdon Winner, Autonomous Technology, MIT Press, Cambridge, 1977; Denis Goulet, The Uncertain Choice, IDOC/North America Inc., New York, 1977.

What the Commission has to say about the specific issues of technology and related industrial policy is sometimes at odds with the available evidence. For example, the Commissioners emphasize that there is little need to fear unemployment arising from technological change, though there is a body of evidence to suggest cause for concern about this.(1) Researchers using what has become known as Long Wave Theory have demonstrated a strong pattern of technologically-induced employment and unemployment. The Commissioners touch on this theory for other purposes but reject it as "exotic", though the "exotic" nature of Long Wave theory merely lies in the fact that it places technological change at the centre of economic development and uses much longer-term evidence from economic historians than is usual. Previous technological change mechanized farming, but the surplus labour was able to find employment in the expanding manufacturing sector and, more recently, in the service sector. But now, information and microelectronic technologies are increasing automation in both manufacturing and service sectors. Some theorists have suggested we may be headed for a future economy where machines do most of the work and only a small cadre of people is involved with research, production and services, leaving most unemployed -- at least, by present standards.(2) Will this scenario come to pass or will the new technologies stimulate new employment in new areas? The jury is still out on the question.

The Commissioners recommend that cost/benefit analysis be used to guide the allocation of R&D funding. As Norman Clark and many others have pointed out,(3) however, there is great difficulty in doing this because research depends on creativity. Research cannot be programmed,

---

(1) Roy Rothwell and Walter Zegveld, Reindustrialization and Technology, Longman, Harlow, 1985; Christopher Freeman, John Clark and Luc Soete, Unemployment and Technical Innovation, Frances Pinter, London, 1982; Frances Stewart, Technology and Underdevelopment, Macmillan, London, 1977.

(2) Larry Hirschhorn, Beyond Mechanization, MIT Press, Cambridge, 1984.

(3) Norman Clark, The Political Economy of Science & Technology, Basil Blackwell, Oxford, 1985.

and the benefits from R&D are uncertain, long-term and dispersed. The Report neither refers to these well-known problems nor suggests how to overcome them.

The Report states that "little evidence links extensive foreign control and deficiencies in Canada's industrial performance".(1) Though the effect of foreign ownership is a highly contentious issue, there is a good deal of evidence to suggest a negative influence. For example, the Science Council concluded in its 1979 paper Forging the Links that extensive foreign ownership of our economy limits our technology capability and our resulting industrial performance.(2) It made a case that Canada has an unusual industrial structure which could be called "truncated"; it is characterized by a lack of R&D, engineering design, and export marketing capability, because it is so heavily made up of foreign-owned subsidiaries which carry out these higher functions at their home bases.

The Commissioners state that "Canada is a fully industrialized nation producing a wide range of manufactured goods".(3) In fact, this country produces predominantly low technology, mature manufactured goods and exports few of them. Excluding resource-related and automotive manufacturing, Canada ran a trade deficit of more than $22 billion in trade of manufactured goods in 1984.(4) Canada is predominantly a staples economy, an exporter of raw and semi-finished materials.

The Report supports the idea of improving government procurement policies for industrial development. This procurement is not linked to

---

(1) Macdonald (1985), Part II, p. 235.

(2) Canada, Science Council of Canada, Forging the Links: A Technology Policy for Canada, Ottawa, 1979.

(3) Macdonald (1985), Part I, p. 216.

(4) Canada, Statistics Canada, Technology and Trade Statistics: Part I, Ottawa, July 1985.

supporting technological innovation, though Rothwell and Zegveld(1) have pointed out that procurement for industrial development is not the same as procurement for technological development. They use the example of the contrasting strategies of Britain and Norway in exploiting North Sea oil. It is generally concluded that the explicit Norwegian technology procurement policies were extremely important for its current world class industrial expertise in the offshore. General British industrial procurement policies did much less to build world-scale industrial capacity. Furthermore, the Commissioners do not link entrepreneurship to technological innovation, as if there were no difference between an entrepreneur setting up a homemade cookie business and one trying to manufacture home market Apple mini-computers!

To be fair, no issue as complex as the prospects for Canada's future economic performance could be tackled without some guesses and tentative interpretations. The Commission could, however, devote discussion to the subject of technology and its role in our economic future. What is technology? Why is it important? What would a coherent policy framework for technology look like? These questions are not touched upon in the Report.

The Commissioners are to be credited with broaching a discussion of technology in several places and for the recommendations they do make concerning the development, use and transfer of technology with a clear industrial focus in mind. Ideally, the Report would move from the general and rhetorical level to the specific policy level on this issue.

To illustrate, in the discussion of R&D in the chapter on industrial policy, the Commissioners state:

> ...the importance to economic growth of expenditures on R&D is hotly debated. The question of the appropriate public policy for a small country such as Canada... is even more controversial.(2)

---

(1) Rothwell and Zegveld (1985), p. 126.

(2) Macdonald (1985), Part II, p. 117.

There is no elaboration of these crucial statements. The issues are simply left hanging.

Even though the Commissioners recognize the importance of technology, their comments are on the whole restricted to the traditional factors of economic policy analysis. A good example of this is their positive reference to a recent popular book, The Next American Frontier,(1) which makes a case for industrial renewal by limiting "paper entrepreneurship" (i.e., shuffling assets between corporations by takeovers) and by concentrating on precision engineering, custom design and manufacturing, and technology-intensive industry. This proposal has major implications for Canada. Are there adequate savings in the country for investment? Are patents too easy or too difficult to obtain? Are there sufficient engineers and scientists? Is skilled labour mobile? Is there an adequate technology information network available? A hundred questions suggest themselves, which the Report would have been wise to address. Instead, it discusses the merger question.

In their analysis of technology or economics, the Commissioners have not used all the available schools of thought that deal with the issue. Why has this happened?

THE CLASH OF DIFFERENT SCHOOLS OF THOUGHT

In order to understand why there seems to be so little consideration of technology at the detailed policy level, it is necessary to digress briefly. Researchers in social science tend to group themselves in various schools of thought which are often in serious conflict. Decision-makers, who must rely on expert advice, must be aware that so-called "scientific" experts may in fact be providing recommendations that another group of experts would claim to be erroneous.

---

(1) Robert Reich, The Next American Frontier, Times Books, New York, 1983.

The reason for this is that scientific knowledge tends to advance in fits and starts, even revolutions, which will then be followed by long periods of quiescence, in which only minor evolutionary adjustments are made to the basic theoretical structure.

A major shift in the school of thought begins when it is first noticed that some research results cannot be explained within the existing theoretical structure.(1) Gradually enough evidence accumulates for the new data to begin to be perceived not as anomalous, but as indicating that the old theory is incomplete. Then a determined effort begins on the part of some investigators to develop a new theoretical structure consistent with all the evidence. Fierce intellectual battles ensue between proponents of the old and new schools until one theory eventually becomes generally accepted.

In the physical sciences, victories are usually clear-cut, but in the social sciences, evidence is never so clear, with the result that the old and new schools of thought often exist side by side, and gradually diverge into different areas of mutual incomprehensibility, for they are essentially speaking entirely different languages and dealing with entirely different concerns.

Just such a clash is taking place now between the dominant school of economics (which is neoclassical) and the technology policy school, over the role of technology in economic development. During the last few decades, researchers from various disciplines have begun to focus on the technology question. A field known as technology policy has coalesced from neoclassical economics, economic history, political economy, political science, history and philosophy of science, environmental impact science, business management, industrial engineering and systems theory. The literature in this new field has mushroomed as dozens of academic, professional and popular journals have been founded, university research

---

(1) Thomas Kuhn, The Structure of Scientific Revolutions, University of Chicago Press, Chicago, 1962.

centres established and government science and technology ministries set up around the world.(1)

Neoclassical economics has generally treated technology as a "black box" or a "residual", the detailed nature of which is not only largely unknown, but also unknowable. There is also a great emphasis on quantification to fit abstract theoretical models. Elements that do not fit into theory, or cannot be measured, tend to be resisted.

Thus the MRC makes the following kinds of statement:

> While a number of authors have attempted to quantify the various sources of technical progress, the term continues to describe a residual category of economic developments about which we know relatively little.(2)

> A discussion of the evolution of industrial structure would obviously be incomplete without some analysis of changes in the extent, nature and sources of improvement in technology. Unfortunately, the process of technological change does not yield easily to such analysis. One approach, however, is to measure rates of growth in total factor productivity within various industries and to accept the result as the rate of technical advance. While there has been considerable progress in making such measurements, this approach has yet to convey much insight into the causes and nature of technical change.(3)

In earlier decades, neoclassical theory largely ignored technology, considering it as external to the economic system, but available off-the-shelf whenever needed, at virtually no cost. Its dominant view in recent years has shifted to conclude that technology is almost completely determined by economic events. The Macdonald Commission's view of technology as depicted earlier -- isolated from economic events, hardware-oriented, relatively uninteresting compared to capital, labour, resource

---

(1) See Scott Tiffin, "Technology Policy Centre", Policy Options, Vol. 5, No. 6, 1985, p. 52-54 for a discussion of this.

(2) Macdonald (1985), Part III, p. 89.

(3) Ibid.

and trade considerations, but in a general sense, very important -- reflects the Commission's acceptance of the neoclassical point of view.

Technology policy is an interdisciplinary field, with no unifying theory and single methodological approach. It tends to be empirical, relying on case studies and direct observation. The concerns of technology policy join with economics in the area of industrial policy, competitive strategies of the firm and in the allocation of resources to R&D. There may be a tendency for technology policy to promote more interventionist policies -- at least in medium-sized industrial states like Canada -- in contrast to the recent conservative drift of many neoclassical economists to fundamentals of free trade and unfettered markets. The reason for this has to do with the fact that technology is a man-made phenomenon. It is not a static factor of production, but one which can be modified quickly and radically. Neoclassical trade theory, in contrast, considers comparative advantages among nations to be founded on factors that are static, or change only slowly, like forest or mineral resources.

In economists' language, technological change allows the artificial creation of comparative advantages which have the potential of producing major changes in worldwide industrial and trading patterns. The Swiss watch industry, for example, was almost destroyed in a few years by the Japanese innovation of digital electronic watches. Technological change has always worked in this way, but in the last few decades, interest in it has become so intense worldwide that its development has been speeded up, its economic impact broadened, and its diffusion made more complete. Technology has become a powerful factor by itself in changing comparative advantages and one which governments have a chance to manipulate by putting resources into scientific education and R&D, and supporting industrial demand for innovations.

Because of this change, one could say that some of the ground rules for economic analysis of trade and economic growth have shifted. They point, for the present at least, towards a potential for greater government involvement in certain national economic areas. In his book, How Ottawa Decides, French(1) points out that there has been a fierce partisan

---

(1) Richard French, How Ottawa Decides, James Lorimer & Co., Toronto, 1984.

struggle in federal policy circles over the issue of government involvement with industrial policy since the beginning of the Trudeau era. As a result, the intellectual debate has become ideologically polarized, and the issues have regrettably been obscured. Witness, for instance, the vitriolic exchange over technology and industry policy in the pages of Policy Options, between Longo and Forward (for the technology school) and Watson (as an extreme partisan of the neoclassical school).(1)

It is important to note that on the level of theory, there is no intrinsic conflict between the two schools of thought; technology policy is not concerned per se with neoclassical methodology and theory. Rather, it is a new concern which opens up a fresh dimension of possibilities for extending theory, improving industrial competitiveness and developing appropriate public policy.

The Commission has avoided discussion of technology policy despite claiming that "determined efforts were made to foster cross-disciplinary thinking". This can be seen by comparing the Report's treatment of two public federal agencies. The Science Council of Canada and the Economic Council of Canada were created to give advice on policy matters relating to industry, technology and the economy (among other things). The Economic Council has tended to advocate free trade and letting market forces work freely; the Science Council, not the only advocate of technology policy but certainly the major one outside the federal government, has tended to advocate selective intervention and protection by government to foster competitive, technology-based industries. While the Economic Council is cited frequently in MRC, reference is made to the Science Council of Canada only twice, both times in regard to fairly minor details which supported the Commission's viewpoint.

---

(1) Frank Longo and William Forward, "Industrial Anti-Policy", Policy Options, Vol. 5, No. 3, 1984, p. 59-60; William Watson, "Freshening the Debate", Policy Options, Vol. 5, No. 3, 1984, p. 54-59.

FREE TRADE AND FREER MARKETS

The Report's limited attention to the importance and dynamics of technology will be shown here to have spilled over to industrial policy, with the result that its main recommendations on free trade and freer markets need to be re-examined.

A. Freer Markets

What the Commissioners mean by a move to a "more market-oriented industrial policy"(1) is not clear. As several commentators have pointed out, Canada has not had an explicit industrial policy for decades but has relied on incremental, reactive policies, thus forcing the provinces to take independent action on their own industrial policies.(2) While the Commissioners state "Canada has relied on intervention too often, too extensively, and in too ad hoc a fashion"(3) to bolster the recommendation that there should be less government involvement, one could equally well argue that the ad hoc nature of such involvement is the fundamental problem, not government involvement per se.

Of course there are limits to the effectiveness of government intervention in industrial development, particularly at the federal level in Canada where differences in regional interests can be strong, but the Commissioners present no analysis of this issue, though stating as their opinion:

> We argue that a highly interventionist industrial policy should be considered only if the world becomes a much darker place than we expect it to be in the future. Otherwise, an industrial policy emphasizing efficiency and excellence is most likely to contribute to Canada's overall goals.(4)

---

(1) Macdonald (1985), Part III, p. 381.

(2) Glen Williams, Not for Export, McClelland and Stewart, Toronto, 1983; Michael Jenkin, The Challenge of Diversity, Science Council of Canada, Ottawa, 1983.

(3) Macdonald (1985), Part VI, p. 425.

(4) Ibid., Part I, p. 272.

Another reason the matter of freer markets is not clear is simply that key aspects of "targeting" and "picking winners", which the Commission is against, are never defined. The whole validity of their argument turns on exactly what is meant by these crucial terms. The Report notes that governments have not succeeded, on balance, at targeting industrial growth, but puts forward little evidence for this statement. For example, the Commission's claim that industrial targeting in Japan has not succeeded would be contested by other qualified observers. As Charles McMillan says:

> Probably no single factor explains the continuing success of Japan's industrial system as the management of knowledge and technology...
>
> Yet for all the success of Japan's technological achievements, there is no doubting the myopia of the United States in the area of technological trade.(1)

This is the essence of the clash of different schools of thought; proponents of the existing economic system simply do not "see" the fundamental change that has occurred to trade and production.

The whole question of targeting, strategies, niches, intervention and markets deserves a much more thorough investigation than the MRC has given it in the final Report. The complexity of the issues militates against any uniform or simplistic solution. At one point (Part III, p. 183), the Report quotes a study by Richard Nelson to support its case for freer markets. However, a closer look at some of Nelson's other works(2) yields quite a different picture from the one the Commission wishes to portray. Nelson argues that technology should be treated as a key factor driving the capitalist engine, and that it can be controlled in certain ways if one understands the nature of its development. Nelson's conclusion is that public policy should not embark upon a narrow, single-minded pursuit of

---

(1) Charles McMillan, The Japanese Industrial System, de Gruyter, Berlin, 1984, p. 93.

(2) Richard Nelson and Stanley Winter, An Evolutionary Theory of Economic Change, Harvard University Press, Cambridge, 1982.

efficiency in markets, but should instead favour a more pluralistic stance of treating every technology case on its own merits. In another study, on the high technology policies of five major countries,(1) Nelson concludes explicitly that targeted policies have been extremely successful in helping nations catch up to the leaders. For the most advanced technologies, though, the situation is not clear. Depending on the particular technology, the industrial, economic and political contexts, intervention may indeed be less successful and even counterproductive. Nelson points out there are some situations where targeting has been a total failure at advancing high technology industries, but there are other cases where it has been successful. It is important to note that he supports government protection for home markets to allow new companies to grow to international scale. His key point is that the technology and economic factors must be considered hand-in-hand; policies for one without the other will not be likely to lead to any improvement.

Nelson's view of technology also suggests that different strategic opportunities are available to us. Canada need not blindly try to imitate Japanese high-technology, mass market industry. We may be more successful in certain areas by consciously staying away from the cutting edge of technology and profiting by good design, as Swedes do for furniture and Italians for ski-boots.(2)

The MRC states:

> It is probably true that most Canadian economists have doubts about the ability of governments [author's emphasis] to pick potential winners and to help them gain a comparative advantage on the international stage.(3)

---

(1) Richard Nelson, High-Technology Policies: A Five-Nation Comparison, American Enterprise Institute for Public Policy Research, Washington, 1984.

(2) The analytical framework for this strategy is developed by Maximo Halty-Carerre, Technological Development Strategies for Developing Countries, Institute for Research on Public Policy, Montreal, 1979.

(3) Macdonald (1985), Part III, p. 182.

Perhaps, however, government could work more closely with industry and researchers so that it may be advised on how to pick technological and industrial areas with broad potential for future development, to which government can then direct appropriate support. The "winner" could be a field of basic science (like genetics) a generic technology (recombinant DNA) an industrial sector (pulp and paper) or a specific firm (such as Northern Telecom). Shepherd has pointed out(1) that Canada already has many such specifically favoured firms (Spar, CAE, Dome, NOVA) as do other countries (e.g., Japan with Nippon Electric, France with Dassault, Sweden with Saab). Some of these are extremely successful.

The Commissioners continue the previous quotation, adding:

> If all countries were to pursue this strategy, the benefits to each nation would, on average, simply match the costs of entering the game.(2)

Of course a zero sum situation like this where none of the players can gain in the long run is theoretically possible, but the practical realities could be vastly different. Witness one example with severe negative consequences to Canada's trade balance. Sweden exports significant quantities of mining and forest machinery all over the world. Sweden has had a long history of close private-public cooperation to promote a national export capacity in mining and forest machinery, continually upgrading the technology content. Canada has historically chosen to support low cost import of such machinery to encourage maximum exports of the raw materials. Canada has never retaliated in kind against this Swedish government industrial targeting, but continues to expand its Swedish imports. In 1984, Sweden exported roughly four times as much in fabricated materials and end-products to Canada as Canada did to Sweden.(3)

---

(1) John Shepherd, "Hidden Crown Corporations: The Private Corporation as a Chosen Instrument", in Remixing the Economy, Tom Kierans (ed.), Institute for Research on Public Policy, Halifax, 1986, p. 23-26.

(2) Macdonald (1985), Part III, p. 182.

(3) Anders Sandberg, A Study of Swedish Technology Policies Promoting Development of Industries Linked to Mine and Forest Exploitation, Ministry of State for Science and Technology, Ottawa, 1986.

Reliance on market forces alone is not likely to correct this situation. While the MRC advocates free trade with the USA and the freer play of market forces, most of the OECD countries are moving towards more intensive planning for technology and industrial development. A recent OECD report on the technology policies of member states(1) is illuminating; it does not recommend any particular actions, but merely reports on existing government policies in respect to technology and innovation. Compare them to the recommendations in the MRC Report.

> Governments...are broadening their policy portfolios to include more indirect assistance to industry, primarily in the forms of tax credits and incentives. A second direction is greater aid for innovation activities downstream from R&D, particularly for applications of the new technologies in manufacturing.(2)

> Regional development has become a prime target, with emphasis on the application of advanced technologies to old industries...the creation of high technology firms ...the development of science parks and the provision of technical advisory services.(3)

> High technologies...are clearly the main objective of present policy. Governments are increasingly involved in planning, financing and managing large programmes in promising technologies. The extent of the involvement is unprecedented in several OECD countries, extending to many governments which normally have a non-interventionist stance.(4)

> Government measures are being extended beyond support for R&D and innovation to include applications, diffusion and commercialization. This trend is likely to spread widely as countries seek to upgrade their technology base and to apply the technologies in other parts of their economy.(5)

---

(1) Robert Brainard and John Madden, Science and Technology Policy Outlook, OECD, Paris, 1985.

(2) Ibid., p. 11.

(3) Ibid.

(4) Ibid.

(5) Ibid.

> Governments are using several other measures to aid their high technology sectors. These include government procurement policies that give preference to domestic products such as computers and telecommunications; relaxation of regulations to permit collaboration among high-technology firms; setting of technical standards which favour the products of domestic firms such as advanced ground transportation systems; and export credits to industries such as aircraft and nuclear energy.(1)
>
> Collectively, these policies and practices can be viewed as a kind of "technological nationalism" which substitutes competition between countries for competition between companies.(2)
>
> Some countries may have little recourse but to turn to government-led programmes which marshal their limited capabilities and resources and focus them on technological targets.(3)

B. Free Trade With the USA

The situation with respect to free trade with the USA is somewhat different from that with respect to freer markets. Whereas the technology policy school clearly tends to a more interventionist approach on behalf of government, it has less to say specifically about free trade. There is a tendency towards recommendations supporting government procurement for innovation, making venture capital more available for technical entrepreneurs and protecting technology-based "infant industries". The MRC recommends all these points itself, although it does not tie them specifically to technology.

The technology policy school would consider that the MRC has put too much emphasis on trade and too little on industry. Such an emphasis reflects our current status as a nation with a small industrial base relying on exports of raw materials. It is a status which can be justified within the neoclassical school of economics if one assumes our comparative

---

(1) Ibid., p. 12.

(2) Ibid.

(3) Ibid.

advantages are more or less fixed. However, those advocating a technology policy are clearly dissatisfied with this proposal, claiming it presents Canadians with a declining standard of living, increased unemployment and limited options for personal development. They would try to use technology to change the comparative advantages and as a tool to move into higher value-added industrial production, which undergoes less trade fluctuation on international markets. This is the explicit strategy used by countries like Japan, Sweden and Korea.

By not examining industrial production sufficiently, the MRC has not taken into account some aspects of scale of production which affect the free trade issue. There is no denying that mass markets have been crucial to much industrial development and successful technological innovation. However, this situation is not static as some new production technologies promise significant cost reductions at smaller output levels. These technologies are generally referred to as FMS, for flexible manufacturing systems. Mass production of some of the kinds of high technology goods, like machine tools and consulting engineering services, which Reich recommends in The Next American Frontier,(1) does not occur as they are so specialized. Export markets are needed, yes, but tariffs for such knowledge-intensive, high value-added products are not necessarily the major problems they face.

The Commission recommends free trade although little is known about what free trade would do to Canada's technology-intensive goods and service industries. There are few studies of Canada's trade in technology-intensive goods and no serious ones of the country's technology-intensive service sector. To fill such gaps, MOSST has mounted research in both areas and the Science Council has set up a Task Force on Free Trade. This sort of work ought to be considered by the free trade negotiating team as soon as it is available.

There are obvious dangers in linking ourselves too closely with any one industrial system. The MRC seems to prefer many actors in the

---

(1) Reich (1983).

private sector making choices on the future to one federal government doing so; why does the same principle of strength from a diversity of options not hold for the trade question as well? Choosing the U.S. as a free trade partner will inevitably affect our patterns of technological and industrial development. Several decades ago, the U.S. was undisputedly the world's technological leader. Now this is not the case; other nations have taken the lead in many areas. We must examine these technology trends and their implications more closely.

It may be difficult to harmonize our existing programs for support of technological development, such as the National Research Council's Industrial Research Assistance Program (IRAP), with those of the Americans, who may claim that subsidy programs like IRAP represent unfair practices which must be abandoned. The U.S. tends to rely less on such R&D subsidy programs and more on extensive defence and aerospace contracting for government support of technology development.(1) Such programs are of limited utility for Canada because its defence industries and home market are so much smaller, and our whole industrial structure is different and so limited.

Canada has already experienced several examples of (more or less) free trade in technology-intensive industries, autos, defence and agricultural machinery. There has been very little study of the impact of free trade on the technological capacity of these industries. The technological capacity is an important factor because it allows the industry to restructure its products and processes in the face of severe and sudden external events, like the steep increase in oil prices in the 1970s and the invasion of superior Japanese auto imports. What few studies exist suggest it is vital to consider the technology factor explicitly. A Science Council study of the auto industry(2) suggests that as a result of the Auto Pact, Canada lost all the independent R&D and design engineering capacity it

---

(1) The extent of U.S. Defence R&D involvement is shown by Franklin Long, "Government Dollars for University Research", Bulletin of the Atomic Scientists, Vol. 42, No. 3, 1986, p. 45-50.

(2) N.B. MacDonald, Canadian Automobile Industry, Science Council of Canada, Ottawa, March 1980.

once had, as these functions were centralized in the U.S. Although Canada is a major assembler of autos, it has no independent design capacity, and must rely totally on the U.S. to redesign our cars to meet the Japanese challenge. A report on the technology aspects of the Defence Production Sharing Agreement(1) shows a widening trade deficit in technology-intensive goods, currently at a cumulative $1.6 billion, with the U.S. In contrast, Canada's defence equipment trade with European NATO countries and Third World, for which no special trade agreements exist, shows a cumulative surplus of $2.6 billion.

Free trade by itself is neither likely to cure all of the problems with Canada's technology-intensive industries nor create new ones. One can only hope that the negotiating team will take into account unsung technology-intensive industries like consulting engineering (where Canadian firms are first, second and fourth largest in the world) and not trade them off against short-term gains, say, in lumber exports where a larger political constituency exists. The Report states:

> ...One means of speeding up the process [of technology diffusion] is to provide the spur of liberalized trade... In addition, minimizing barriers to the flow of direct investment would also encourage early Canadian adoption of new technology.(2)

These are definitely possibilities; so are the exactly opposite courses of maximizing protectionism for a home market and erecting barriers to foreign investment. Japan is well known for this. Sweden used protectionist measures as well, to make equally impressive technological and industrial advances which have far outstripped Canada's in some areas. Sandberg demonstrates how Sweden's prohibition of foreigners owning mining properties led to a determined national response to build up a fully integrated mining, equipment and service industry which now exports its expertise world-wide.(3) Some kinds of protection policies can be crucial for technological and industrial development. It all depends on what other policy, cultural and economic factors come into play.

---

(1) Canada, Ministry of State for Science and Technology, Canada's Defence Industry and Technology, Ottawa, 3 October 1985.

(2) Macdonald (1985), Part II, p. 205.

(3) Sandberg (1986).

RECOMMENDATIONS

The debate over the Macdonald Commission's work is continuing. The free trade recommendation has become an active policy option and the recommendation for government to rely more on market forces is finding expression in the Nielsen Task Force. The positions taken by the MRC on Canada's future prospects for economic development need to be examined with reference to the technology school of thought in order to arrive at more balanced recommendations.

A careful study of the positions advocated by the technology policy school will show few irreconcilable differences between them and the recommendations of the MRC. Since the Report itself suggests (Part VI, p. 425) that different national approaches to industrial policy should be monitored to discover their applicability to Canada, enhancement of the original recommendations should be possible if a good debate takes place. While the Report uses the rhetoric of a strong free market position, it actually admits to many interventions which overlap those advocated by the technology policy school. For example, the Science Council's latest book on industrial policy focuses on the need for exports, competitiveness, international rules of conduct for trade, market demand pull, productivity, consensus among actors, policy flexibility and long-range vision.(1) Such recommendations are to a large extent just a more focused and fully-developed elaboration of those of the Royal Commission. In effect, industrial policy advocated by the technology policy school is largely an extension of the Commission's industrial framework.

---

(1) Canada, Science Council of Canada, Canadian Industrial Development, Ottawa, September 1984.

Further discussion of the Report should consider these general points:

- The need to develop a broad vision for the future of Canada as a technological society. At the beginning of this paper is a quotation from the Report castigating the U.S.S.R. for not becoming a technological society, while reaching the status of an industrial society. To a large extent, Canada is not yet an industrial society and our technological strength is not firmly rooted. We should explore what a technological society means in the Canadian context: where we want to go, why we want that direction, how we propose to control the forces tending to push us off course and how we can harness changes in technological knowledge to help us attain our goals. The Commission is completely correct when it emphasizes the great importance of technology for Canada's future. We must tackle this issue head-on and generate a vision to carry us into the next century.

- Within this vision, technology should be considered explicitly, not just as a subset of economic events. Technology needs its own framework, as Tillett, to name just one, has pointed out.(1)

- Technology should be considered in concert with economics. The two are tightly interrelated; little progress will be made in encouraging industrial development without both factors working together.

- In free trade bargaining with the U.S., the Canadian negotiators should be aware of the unique importance of technology-intensive industries dealing with goods and services.

---

(1) Anthony Tillett, "Technology Needs a Framework", Policy Options, January 1986, p. 19-23.

° Much more research is needed into technology policy issues. In Canada, the field is far less developed than in Europe or the U.S., with the result that policymakers often know little about the Canadian situation and are forced to rely too heavily on foreign research. Some of the generic topics needing more investigation are:

- new product and process innovation cycle;
- federal-provincial roles;
- strategic technologies;
- new market niches;
- revitalizing mature industries;
- cooperative mechanisms for university, government and industry;
- using resource exploitation to develop related industrial capacity;
- balancing curiosity-oriented science and mission-oriented research;
- upgrading industrial design.

REFERENCES

Brainard, Robert and John Madden, Science and Technology Policy Outlook, OECD, Paris, 1985.

Canada, Ministry of State for Science and Technology, Canada's Defence Industry and Technology, Ottawa, 3 October 1985.

Canada, Royal Commission on the Economic Union and Development Prospects for Canada, Donald S. Macdonald (Chairman), Report, Supply and Services, Ottawa, 1985.

Canada, Science Council of Canada, Canadian Industrial Development, Ottawa, September 1984.

Canada, Science Council of Canada, Forging the Links: A Technology Policy for Canada, Ottawa, 1979.

Canada, Statistics Canada, Technology and Trade Statistics: Part I, Ottawa, July 1985.

Clark, Norman, The Political Economy of Science & Technology, Basil Blackwell, Oxford, 1985.

Ellul, Jacques, The Technological Society, Alfred Knopf, New York, 1964.

Freeman, Christopher, John Clark and Luc Soete, Unemployment and Technical Innovation, Frances Pinter, London, 1982.

French, Richard, How Ottawa Decides, James Lorimer & Co., Toronto, 1984.

Goulet, Denis, The Uncertain Choice, IDOC/North America Inc., New York, 1977.

Halty-Carerre, Maximo, Technological Development Strategies for Developing Countries, Institute for Research on Public Policy, Montreal, 1979.

Hirschhorn, Larry, Beyond Mechanization, MIT Press, Cambridge, 1984.

Jenkin, Michael, The Challenge of Diversity, Science Council of Canada, Ottawa, 1983.

Kuhn, Thomas, The Structure of Scientific Revolutions, University of Chicago Press, Chicago, 1962.

Long, Franklin, "Government Dollars for University Research", Bulletin of the Atomic Scientists, Vol. 42, No. 3, 1986.

Longo, Frank and William Forward, "Industrial Anti-Policy", Policy Options, Vol. 5, No. 3, 1984.

MacDonald, N.B., Canadian Automobile Industry, Science Council of Canada, Ottawa, March 1980.

McMillan, Charles, The Japanese Industrial System, de Gruyter, Berlin, 1984.

Marcuse, One-Dimensional Man, Beacon Press, Boston, 1964.

Mumford, Lewis, The Myth of the Machine, Harcourt, Brace, Jovanovich, New York, 1970.

Nelson, Richard and Stanley Winter, An Evolutionary Theory of Economic Change, Harvard University Press, Cambridge, 1982.

Nelson, Richard, High-Technology Policies: A Five-Nation Comparison, American Enterprise Institute for Public Policy Research, Washington, 1984.

Reich, Robert, The Next American Frontier, Times Books, New York, 1983.

Rothwell, Roy and Walter Zegveld, Reindustrialization and Technology, Longman, Harlow, 1985.

Sandberg, Anders, A Study of Swedish Technology Policies Promoting Development of Industries Linked to Mine and Forest Exploitation, Ministry of State for Science and Technology, Ottawa, 1986.

Shepherd, John, "Hidden Crown Corporations: The Private Corporation as a Chosen Instrument", in Remixing the Economy, Tom Kierans (ed.), Institute for Research on Public Policy, Halifax, 1986.

Stewart, Frances, Technology and Underdevelopment, Macmillan, London, 1977.

Tiffin, Scott, "Technology Policy Centre", Policy Options, Vol. 5, No. 6, 1985.

Tillett, Anthony, "Technology Needs a Framework", Policy Options, January 1986.

Williams, Glen, Not for Export, McClelland and Stewart, Toronto, 1983.

Winner, Langdon, Autonomous Technology, MIT Press, Cambridge, 1977.

ACCO®

ACCOPRESS™MMC

YELLOW	25070	JAUNE
*BLACK	25071	NOIR*
*BLUE	25072	BLEU*
RL. BLUE	25073	RL. BLEU
*GREY	25074	GRIS*
GREEN	25075	VERT
RUST	25078	ROUILLE
EX RED	25079	ROUGE

ACCO CANADA INC.
WILLOWDALE, ONTARIO

* INDICATES 75% RECYCLED 25% POST-CONSUMER FIBRE

*SIGNIFIE 75 % FIBRES RECYCLÉES, 25 % DÉCHETS DE CONSOMMATION

BALANCE OF PRODUCTS 25% RECYCLED

AUTRES PRODUITS: 25 % FIBRES RECYCLÉES


0 50505 25072 1